Renewable Energy:

POWER SUPPLY
&
ENVIRONMENTAL CHALLENGES

IN CALIFORNIA

December 5, 2001, Wednesday
State Capitol, Room 447
1:30 P.M. to 5 P.M.

<u>THE CALIFORNIA STATE LEGISLATURE</u>

Assembly Natural Resources Committee

RENEWABLE ENERGY
POWER SUPPLY AND ENVIRONMENTAL CHALLENGES IN CALIFORNIA

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Room 447
Sacramento, California
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<u>AGENDA</u>

1:30 P.M. **Welcome by the Chair, Assemblymember Howard Wayne (AD 78)**

1:35 P.M. **Framing a California Energy Policy: Economic & Environmental Goals**
Michael Moore, Commissioner, California Energy Commission, Sacramento, CA

1:55 P.M. **Understanding Fuel Cells**
John Lynn, President, American Methanol Institute, Washington, D.C.

2:15 P.M. **Wind Power for a Clean Future**
Ed Maddox, Assistant Vice President, SeaWest, San Diego, CA

2:35 P.M. **Integrating Environmental and Energy Priorities: Solar Power, etc.**
Cameron Moore, Director, Building and Utility Markets, BP Solar, Fairfield, CA

2:55 P.M. **Waste-to-Energy, Geothermal, Hydro, Landfill Gas, Biomass, etc.**
Paula Soos, Director of State Governmental Relations, Covanta Energy, Fairfield, NJ

3:15 P.M. **Incentive Programs: Experiences From an Engineering Services Provider**
Dan Arvizu, Senior Vice President, CH2M Hill, Denver, CO

3:35 P.M. **Successful Policies for Clean, Affordable Energy**
Hal Harvey, President, Energy Foundation, San Francisco, CA

Experiences with Renewable Energy

3:55 P.M. *Gary Schoonyan, Director of Regulatory Policy and Affairs, Southern California Edison, Pasadena, CA*

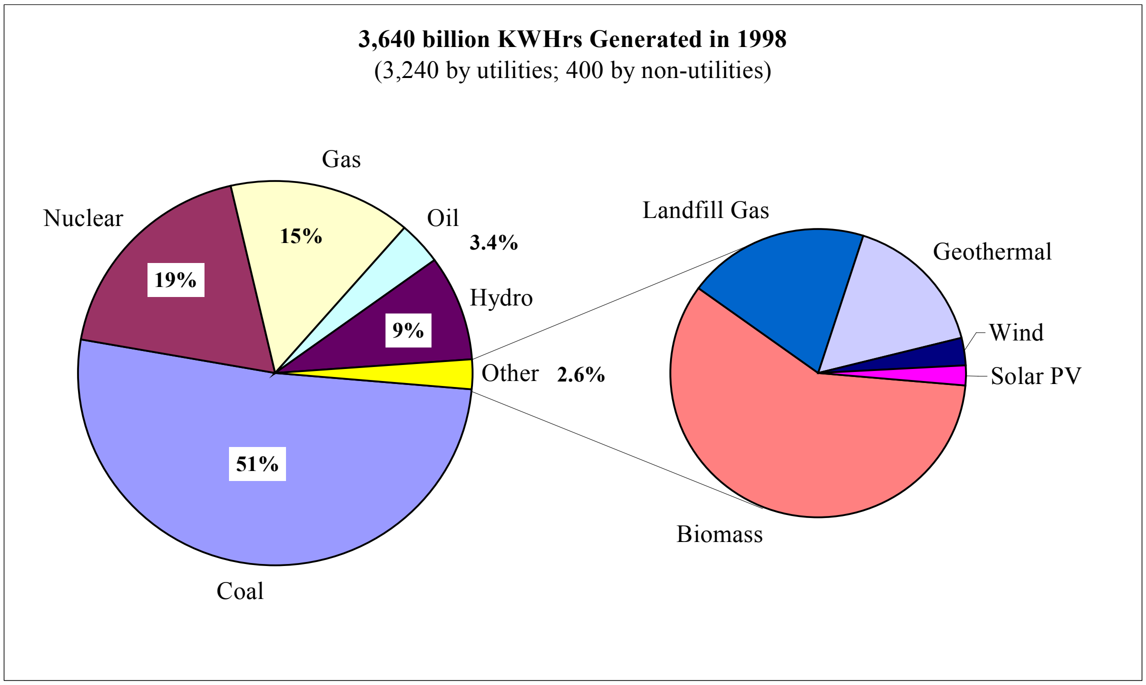
4:15 P.M. *William Manheim, Chief Counsel, Pacific Gas and Electric Company, San Francisco, CA*

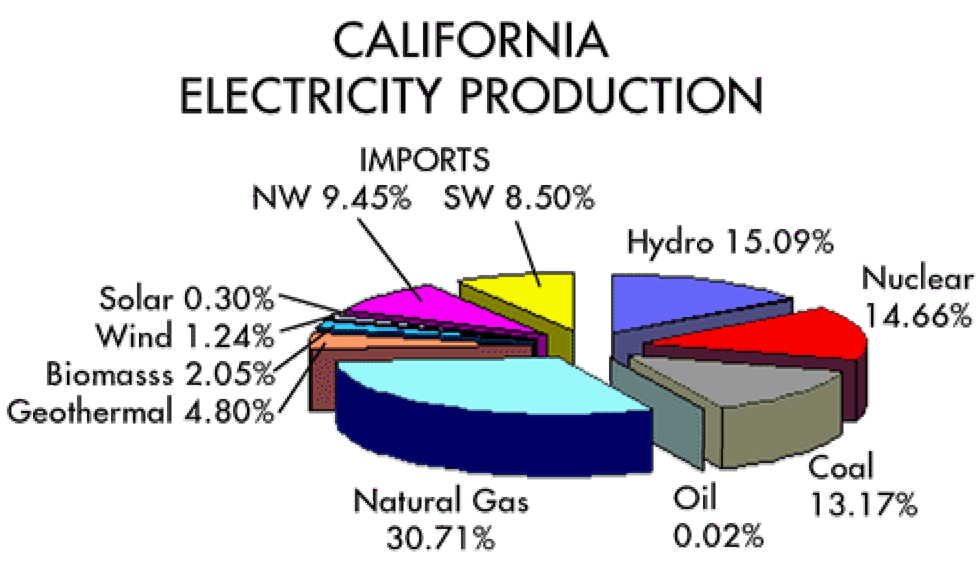
4:35 P.M. *Vincent Schwent, Senior Project Manager, Sacramento Municipal Utility District, Sacramento, CA*

4:55 P.M. **Public Forum**

Electricity Generated by Source in the U.S.

Electricity from renewable sources (non-hydro) remains low (3%) and is not projected to grow during the next 20 years in the U.S. Hydro will decline.





Electricity Generated by Source in CA

Resource Type	Gigawatt-Hours	Percentage
Hydro	41,617	15.09%
Nuclear	40,419	14.66%
Coal[1]	36,327	13.17%
Oil	55	0.02%
Natural Gas	84,703	30.71%
Geothermal	13,251	4.80%
Biomass & Waste	5,663	2.05%
Wind	3,433	1.24%
Solar	838	0.30%
Imports - NW	26,051	9.45%
Imports - SW	23,436	8.50%
	275,793	100.00%

Note: To convert from gigawatt hours into megawatts (MW), divide the number of gigawatts by 8,760 then multiply by 1,000 to get MW.

I. Definition of Renewable Energy

Since the early 1980s, renewable energy technology has advanced beyond the research stage and moved into commercial applications and utility integration. These technologies include wind power, geothermal power, solar or photovoltaic (PV) power, small-scale hydroelectric power, biomass powered thermal generation, and emerging fuel cell technologies. Each of these renewable energy technologies has its benefits and drawbacks applicable to economics: market requirements and resource availability.

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1 Amount of electricity produced from coal includes out-of-state power plants owned by California utilities, or which have long term contracts to supply electricity solely to California. This electricity produced from these coal-fired plants is not designated as an "import" even though the plants are located outside the state. The 15 small coal-fired power plants located within California have a name plate capacity of only 550 megawatts; less than one percent of total state capacity.

As the cost to produce clean, reliable, renewable energy becomes more competitive with traditional fossil fuel sources, deregulation and consumer choice too become factors. Many countries and U.S. states have deregulated or currently debate de-regulating their utility industries, allowing for competition and customer choice. Many customers choose to purchase renewable energy through their local utility or green power marketers. With consumer demand rising, electric utilities must consider how to make renewable energy available.

International protocols also have a significant impact on the development of renewable energy technologies and implementations. Through multi-lateral agreements, nations voluntarily place limits on the amount of carbon emissions and other greenhouse gases (GHGs). These voluntarily limits open markets for renewables where none existed before. Future implementations of carbon emissions credit trading may also increase the demand for clean, non-depleting, non-emitting renewable energy sources.

Consumers, utilities, and governments have begun to purchase renewable energy. The adoption of utility scale renewable energy will continue to increase in the foreseeable future.

Western Grid

- One of three grid interconnections in North America
- Capacity: 160,000 Megawatt (MW)
- 1.8 million miles across 13 states and parts of Canada and Mexico, serving over 71 million people
- Over 115,000 circuit miles of transmission
- Organized into four areas:
  - Rocky Mountain
  - California-Mexico
  - Arizona-New Mexico-Southern Nevada
  - Northwest Power Pool

Source: 2001 Information Summary
Western States Coordinating Council (WSCC)

II. Projected Gas Plants May Overwhelm Gains in Renewable Energy

Although solar and wind applications may double or even quadruple their growth from 2000-10, their contribution to national electricity supply will barely register as the U.S. builds numerous gas plants and extends nuclear reactors. Hydropower generation has declined with drought and the mothballing of some dams. As of March 2001, over 300,000 MW of gas plant capacity is being planned for coming on line between now and 2004. (Source: Worldwatch Institute, *Vital Signs 2001* (New York: W.W. Norton & Company, 2001), pp. 40-47.

SOURCE	1990	1995	2000	2005	2010
Coal	54.1%	55.6%	53.3%	53.2%	51.7%
Nuclear	20.9%	21.2%	21.5%	20.2%	19.2%
Gas	9.1%	8.5%	11.6%	14.4%	17.7%
Oil	3.5%	2.3%	2.3%	2.2%	1.9%
Non-RE	87.6%	87.6%	88.8%	89.9%	90.5%
Hydro	10.2%	10.0%	8.8%	7.4%	6.5%
Biomass	1.2%	1.2%	1.2%	1.3%	1.4%
Landfill Gas	0.4%	0.6%	0.6%	0.6%	0.7%
Geothermal	0.6%	0.5%	0.5%	0.6%	0.6%
Wind	0.1%	0.1%	0.1%	0.1%	0.2%
Solar PV	0.0%	0.0%	0.0%	0.1%	0.1%
Fuel cells	0.0%	0.0%	0.0%	0.0%	0.0%
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

III. State Renewable Energy Programs Proliferate in Late 1990s

Needs to diversify energy sources and preserve some gains for renewable energy in the face of competition led many states to establish programs aimed at promoting market pull (rebates, interest subsidies, low-income assistance), and at developing a stronger supply base. None of the state programs have a national focus. (Source: Database of State Renewable Programs <http://www.dcs.ncsu.edu>).

					($Mil)	($Mil)	
State	**RE State Funding Program**	**Mechanisms**	**Started**	**Ending**	**Total**	**Per Year**	**Rate Source**
CA	RE Trust Fund	Rebates, investments	Mar-96	2002	$540	$100	2-3 mils / KWh
OR	Public Benefits Fund	Low income, weatherizing	Jun-99	2009	$350	$70	3% tax on electric
DE	DE Public Benefits Fund	Low income subsidies	Mar-99	2004	$10	$2.30	.1 mil / KWh
NJ	Public Benefits Fund	Peak load reduction	Mar-01	2008	$360	$120	Bond funding
NY	Public Benefits Fund	EE, Peak reduction	May-96	2006	$234	$150	0.6 mils / KWh
CN	RE Investment Fund	Grants, investments	Apr-98	2003	$118	$24	
MA	Energy Efficiency Fund	Grants, investments	Nov-97	2002	$500	$100	2-3 mils / KWh
MA	RE Trust Fund	Grants, investments	Nov-97	2002	$150	$30	1 mil / KWh
RI	Public Benefits Fund	EE, weatherizing	Aug-96	2001	$85	$8	2.3 mil / KWh
IL	Clean Energy Commun. Trust	Grants, investments	May-99	2008	$250		Settlement / PECO
IL	RE Trust Fund	Grants, investments	Jan-98	2008	$50	$5	50 cents / mo.
OH	EE Revolving Fund	Loans for RE, weatherize	Jun-99	2011	$100	$100	Self funding
WI	Public Benefits Fund	Low income, weatherizing	Oct-99	2004	$4	$1	
MT	Systems Benefit Fund	Grants, investments	Apr-97	2003	$50	$15	1 mil / KWh
NM	Systems Benefit Fund	Solar power, low-income	Jun-00	2007	$4	$1	0.3 mils / KWh
		Totals			$2,805	$726	

IV. California Renewable Energy Efforts

Two programs in California endeavor to ensure the state's support for renewable energy. These programs are known as: Public Interest Energy Research (PIER) and the Renewable Energy Program (REP). PIER & REP promote environmental and renewable technology for the purpose of creating products that conserve natural resources and increase system and end-use efficiency.

As a result of California's deregulated electricity market, retail sellers no longer conduct public interest research and development as they historically did in a regulated environment. The California Energy Commission (CEC) has continued California's public interest research and development and support for renewable energy technologies through PIER and REP. According to the CEC, PIER and REP have succeeded since their inception in 1998.

A. Public Interest Energy Research (PIER)

PIER awards contracts and grants to support work which addresses specified energy issues in California. PIER supports research in innovative small grants, building end-use efficiency, industrial/agricultural/water end-use efficiency, renewable energy technologies, environmentally preferred advanced generation, energy-related environmental research, and strategic energy.

B. Renewable Energy Program (REP)

REP enables new and existing projects to continue to provide California with dependable, diversified renewable energy. Specifically, REP provides support for new renewable resource development, competitiveness among existing renewable resources, deployment of emerging renewable technologies, and customer renewable energy resource purchases. According to the CEC, REP has reduced the declining trend in renewables generation in California by building market demand and gaining consumer confidence in renewable energy.

V. The National Landscape

While no other state has a program identical to California's, many other states support similar issues. Connecticut, for example, has a clean energy fund that provides investment in its green energy market. Massachusetts has a large public goods program, which is similar to California's, but has not yet been implemented. New York has a program intended to overcome market barriers for renewable power by providing competitive solicitation for funds. New York also has a research and development program and a program to stimulate the implementation of grid-connected photovoltaic systems. Texas has a renewable portfolio standard, which requires utilities to purchase a specific amount of renewable energy. Arizona has a limited-scale renewable portfolio standard, and Nevada is currently investigating the possibilities of such a standard. Oregon has a systems benefit charge program that, among other things, funds new renewable power development, and has plans for a customer credit program.

VI. Types of Renewable Energy Discussed in this Hearing

A. Wind Power[2] for a Clean Future

Wind power was once confined to California, but during the last three years, wind farms coming online in Minnesota, Iowa, Texas, Colorado, Wyoming, Oregon, and Pennsylvania have boosted U.S. capacity by half from 1,680 to 2,550 MW. Wind is a vast, worldwide source of energy. The U.S. Great Plains are the Saudi Arabia of wind power. Three wind-rich U.S. states — North Dakota, Kansas, and Texas — have enough harnessable wind to meet national electricity needs. Moreover, a 3,000-MW wind farm in the early planning stages in South Dakota, near the Iowa border, is 10 times the size of the Oregon/Washington wind farm. Named Rolling Thunder, this project, initiated by Dehlsen Associates and drawing on the leadership of Jim Dehlsen, a wind energy pioneer in California, is designed to feed power to the midwestern region around Chicago.

Wind Energy Projects and Wind Energy Potential in CA

Installed MW	Planned MW	Harnessable Wind Potential Average MW	Annual billion kWh	Wind Potential Rank in U.S.
1,604.00	455.30	6,770	59	17

Of renewable technologies, wind power is the fastest growing energy source on the market today. The reasons for wind power's tremendous growth are numerous. Advances in wind turbine technology, drawing heavily from the aerospace industry, have lowered the cost to produce of wind energy power from $0.38/kWh in the early 1980s to as low as $0.04/kWh to $0.06/kWh depending on the wind regime and the financial structure of the project.

Wind, now competitive with fossil fuels, is already cheaper in some locations than oil or gas-fired power. With major corporations, such as ABB, Shell International, and Enron plowing resources into this field, further cost cuts are in prospect.

China can double its existing generating capacity from wind alone. Densely populated Western Europe can supply all of its electricity needs from offshore wind power.

Moreover, the turbine technology has evolved significantly since the 1980's. Equally as significant, governments and legislators recognize the importance of renewables in the energy mix, and work to facilitate the utility scale implementation of wind and other renewable technologies.

In recent years, wind energy projects have proven reliable and economically feasible across a wide variety of wind and temperature extremes. Wind power has become increasingly competitive with conventional fuel source power plants.

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[2] This section relies and paraphrases extensively from: Brown, Lester. *Wind Power: The Missing Link in the Bush Energy Plan*. May 31, 2003. http://earth-policy.org/Alerts/Alert14.htm.

Wind plants also offer a means of achieving corporate or governmental policies regarding environmental stewardship: the non-polluting, non-depleting, renewable aspects of wind power. The numerous benefits of wind power seem to ensure its viability both now and into the future.

Top Ten Countries[3]
With Installed Wind Power, 2000

Country	Installed Wind Power (MW)
Germany	6,113
United States	2,554
Denmark	2,300
Spain	2,235
India	1,167
Netherlands	449
Italy	427
United Kingdom	406
China	265
Sweden	231

Inexpensive electricity from wind can use it to electrolyze water, producing hydrogen. Surplus wind power can be stored as hydrogen and used in fuel cells or gas turbines to generate electricity, leveling supply when winds are variable. Hydrogen is the fuel of choice for the new, highly efficient, fuel cell engine that every major automobile manufacturer currently attempts to develop. For example, DaimlerChrysler plans to market fuel cell-powered cars in 2003. Unsurprisingly, Ford, Toyota, and Honda will probably not trail far behind.

With the advancing technologies for harnessing wind and powering motor vehicles with hydrogen, perhaps a future exists where farmers and ranchers can supply not only much of the country's electricity, but much of the hydrogen to fuel its fleet of automobiles as well. For the first time, the United States has the technology and resources to divorce itself from Middle Eastern oil.

[3] American Wind Energy Association.

B. Understanding Fuel Cells

The impact of GHGs emissions on global climate is of growing concern throughout the world, and must be carefully considered when evaluating various alternatives to petroleum based fuels such as gasoline and diesel. Methanol has long been known to offer a great diversity of fuel applications with environmental, economic and consumer benefits. Cars, trucks and buses running millions of miles on methanol may perhaps replace the use of gasoline and diesel fuels in conventional engines.

Methanol can be made from any renewable resource containing carbon, such as seaweed, waste wood and garbage. Renewable sources of hydrogen can be converted to methanol by reaction with carbon dioxide, which can even be extracted from the atmosphere. Converting hydrogen to liquid methanol makes it readily available at ambient temperature and pressure.

To achieve success, an alternative fuel must have a large base of conveniently located fueling stations. As a practical alternative, methanol is similar to gasoline, compatible with the existing gasoline infrastructure.

Today, methanol is produced from natural gas in production plants with 60% total energy efficiency. Most plants supplement their feedstock with purchased carbon dioxide that would otherwise have been released to the atmosphere. New production processes will push plant efficiency to above 70%, and provide an economic use for vast quantities of flared natural gas from offshore oil platforms and other sites.

Electric vehicles (EVs) offer hope of displacing petroleum fuels, but current battery technology severely limits performance. Rapid advancement of fuel cell technology promises to provide an EV propulsion unit with the performance of current cars. The most practical carrier of hydrogen to run these fuel cells is methanol.

Methanol offers a significant hope for early and broad introduction of fuel cells that will make EVs practical within the next decade. Whether reformed to provide hydrogen for conventional fuel cells or used directly in the latest liquid, fed cells, methanol can overcome the greatest remaining obstacle to commercialization, by offering the only economical way to transport and store the hydrogen needed for fuel cells. Methanol fuel cells could greatly reduce carbon dioxide emissions from vehicles and virtually eliminate smog and particulate pollution.

1. How Fuel Cells Work

Inside the direct methanol fuel cell, a catalyst-coated membrane separates a negatively charged chamber filled with a methanol/water solution, and a positively charged chamber filled with air. The membrane allows hydrogen ions from the methanol to pass through from the negative to the positive side, creating an electric current.

The fuel cell converts the chemical energy of a fuel directly into electrical current without burning it. Most fuel cell research has focused on using gaseous hydrogen as the fuel source.

In the early 1990s, researchers at the National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory (JPL) discovered a way to use liquid methanol as a hydrogen carrier to power a fuel cell. The developers work, under a U.S. military contract to supply a power pack for field radios, to create a unit about the size of a thick paperback book, which can run continuously for weeks at a time, produce 50 watts of power, consume about a pint of methanol fuel per day, and emit only water and carbon dioxide.

The direct methanol fuel cell is simple, relatively inexpensive to manufacture, has no moving parts, runs relatively cool -- below the boiling point of water -- and is highly efficient. Methanol, a liquid fuel produced largely from domestic natural gas, can use the existing gasoline fueling infrastructure.

2. <u>Public-Private Fuel Cell Partnership</u>

NASA's JPL, with DTI Technologies, Inc. of Los Angeles, works to develop a fuel cell powered by a water-methanol mixture and air. The methanol fuel cell may power the electric battery car -- dubbed the zero emission vehicle (ZEV) -- and a wide range of commercial applications from lawnmowers and weed eaters, to consumer electronics and home auxiliary power units.

3. <u>Methanol Fuel Cell Buses</u>

Georgetown University has taken fuel cell technology currently used to provide all of the electrical power for the Space Shuttle, and applied it to transit buses. The university played a lead role in the development of three 30-foot methanol fuel cell buses, and works with the Federal Transit Administration to commercialize a methanol fuel cell-powered 40-foot transit bus.

The fuel cell power system for transit buses is based on an in-depth study conducted by the Los Alamos National Laboratory for the university. The methanol fuel cell buses have a range similar to their diesel-fueled predecessors, exhaust emissions that approach zero and an energy efficiency that allows methanol to compete with diesel.

Between 1970 and 1990, the number of vehicle miles traveled doubled from one to two trillion miles. Although a current car emits far less pollution, the increasing number of cars driving farther and farther results in growing pressure to reduce pollution. Motor vehicles account for about one half of all hydrocarbon and nitrogen-oxide pollution that combine to form ground-level ozone -- the smog that chokes our cities.

The ZEV has held out the promise of being inherently clean (although it is recharged from the electric grid supplied by generating facilities that pollute). However, current electric vehicle battery development has encountered barriers that it has yet to overcome. Rapidly emerging fuel cell technologies offer the opportunity to make the promise of ZEVs practical.

A fuel cell functions somewhat like an ordinary battery: one "pole" (electrode) of the cell is supplied with air or oxygen, and the other with a hydrogen-rich fuel. The resulting chemical reaction creates an electric current as electrons move to one electrode and positive ions to the other. The leading candidate to supply hydrogen to this electrochemical reaction is methanol produced from clean natural gas. Successful demonstrations of methanol-powered fuel cells have been conducted by JPL, Los Alamos National Laboratory, Ballard Power Systems, Detroit Center Tool, International Fuel Cells and Mechanical Technology, Inc.

C. Integrating Environmental and Energy Priorities: Solar Power

Solar power to produce electricity is not the same as using solar to produce heat. Solar thermal principles are applied to produce hot fluids or air. PV principles are used to produce electricity. A PV panel is made of the natural element, silicon, which becomes charged electrically when subjected to sunlight.

This electrical charge is consolidated in the PV panel and directed to the output terminals to produce low voltage (direct current) - usually 6 to 24 volts. The most common output is intended for nominal 12 volts, with an effective output usually up to 17 volts.

The intensity of the sun's radiation changes with the hour of the day, time of the year and weather conditions. To be able to make calculations in planning a solar power system, the total amount of solar radiation energy is expressed in hours of full sunlight per m^2, or "Peak Sun Hours." This term represents the average amount of sun available per day throughout the year.

It is presumed that at Peak Sun Hours, 1000 W/m^2 of energy reaches the surface of the earth. One hour of full sun provides 1000 Wh per m^2 = 1 kWh/m^2 - representing the solar power received on a cloudless summer day on a surface directed towards the sun. The daily average of Peak Sun Hours, based on either full year statistics, or average worst month of the year statistics, for example, is used for calculation purposes in the design of the solar power system.

D. Waste-to-Energy, Geothermal, Hydro, Landfill Gas, Biomass, etc.

By processing non-hazardous municipal solid waste, waste-to-energy operations conserve landfill space and fuel oil. These projects usually feature state-of-the-art air pollution controls. California's 36 biomass power facilities convert approximately seven million tons of waste wood and agricultural residues into clean renewable fuels, including geothermal, hydroelectric, municipal solid waste and waste wood. These facilities serve as waste management systems and may reduce environmental risks and liabilities. For example, some biomass power facilities divert wood waste from landfills. Moreover, using agricultural residues as fuel may reduce air pollution that would otherwise occur from open burning.

By processing municipal solid waste and using it as a fuel to generate clean, renewable energy, biomass power facilities may offer an environmentally sound alternative to landfills, conserve other energy resources and offer communities waste disposal at a competitive price.

About the Witnesses
(alphabetical order)

Dan E. Arvizu, Ph.D., CH2M HILL Energy

Dr. Dan Arvizu is currently a Senior Vice President and Technology Fellow in the CH2M HILL Energy, Environment, and Systems Business Group in Denver, Colorado. Prior to joining CH2M HILL, Dr. Arvizu served 21 years at the Sandia National Laboratories in Albuquerque, New Mexico and 4 years at Bell Telephone Laboratories in Denver, Colorado. He received his Bachelor's of Science in Mechanical Engineering from New Mexico State University and holds the Master's of Science and Ph.D. degrees also in Mechanical Engineering from Stanford University.

Hal Harvey, Energy Foundation

Hal Harvey is the President of the Energy Foundation, a joint initiative of The John D. and Catherine T. MacArthur Foundation, The Pew Charitable Trusts, The Rockefeller Foundation and the Joyce Mertz-Gilmore Foundation. From 1989 to 1990, Mr. Harvey served as executive vice president of the International Foundation. Mr. Harvey has B.S. and M.S. degrees from Stanford University in Engineering, specializing in Energy Planning.

John E. Lynn, American Methanol Institute

John E. Lynn is President and CEO of the American Methanol Institute (AMI), in Washington, D.C. He came to AMI after spending more than 25 years in senior positions on Capitol Hill, most recently as chief of staff to Senator Bennett Johnston (D-LA) who chaired the Senate Energy Committee and the Appropriations Subcommittee on Water and Power. He is a native of Oklahoma, and holds a Bachelor of Arts degree from the University of Oklahoma. He and his family reside in Arlington, Virginia.

Edward E. Maddox, SeaWest

Edward E. Maddox is Assistant Vice President and a Project Manager of Development at SeaWest. Mr. Maddox holds a Bachelor of Science degree in Geology, With Honors, from the University of Derbyshire, U.K., and a Master of Science degree in Construction Management from the University of Science and Technology, Loughbrough, U.K.

William Manheim, Pacific Gas & Electric Company

Bill Manheim is Chief Counsel-Generation for PG&E. He represents PG&E before the CPUC and FERC on energy-related matters. Mr. Manheim joined PG&E in 1987 after graduating from the Boalt Hall School of Law, University of California Berkeley. Over the years, Mr. Manheim has worked on Qualifying Facility contract development, electric industry restructuring, electric transmission open access, AB 1890 implementation, power procurement, power plant divestiture and, most recently, PG&E's bankruptcy and Plan of Reorganization.

Cameron Moore, BP Solar

Mac serves as the Director of Building and Utility Markets for BP Solar, one of largest suppliers of PV systems and components. Prior to joining BP, Mac worked as deputy director of the Solar Energy Industries Association in Washington, D.C., and at commercial and investment banks in New York City. Mac graduated from Middlebury College and New York University's Stern School of Business.

Michael Moore, California Energy Commission

Michael C. Moore serves on California Energy Commission. Commissioner Moore, who lives in Albion, California, was a consulting economist prior to coming to the Commission. From 1993 to 1994, he served on the State Board of Landscape Architects. Commissioner Moore received a B.S. Degree in Geology and Natural Resources from Humboldt State University, Arcata; a Master's Degree in Land Economics from the Ecology Institute at the University of California, Davis; and a Ph.D. in Economics from University of Cambridge, England.

Vincent Schwent, Sacramento Municipal Utility District

Dr. Schwent currently serves as a Senior Project Manager with the Sacramento Municipal Utility District (SMUD) where he directs their marketing of PV to both residential and commercial customers within and outside of the SMUD territory. Prior to SMUD, he worked at the CEC heading their efforts to accelerate the commercialization of PV.

Gary Schoonyan, Southern California Edison

Gary Schoonyan, as Director of Regulatory Policy and Affairs, is currently responsible for Edison's interface with the California Public Utilities Commission, the California Energy Commission and the California Power Authority on electric system planning, operating and electric market matters. Prior to these duties, Gary spent five years as Edison's Chief Planning Engineer, four years responsible for Edison's bulk-power scheduling and generation dispatch operations, including the Company's multi-billion dollar fuel and purchased power budget and eight years overseeing the construction and operation of Edison's real-time dispatch and control systems. Gary received his Bachelors of Science degree in Electrical Engineering from California State University at Los Angeles and did his graduate work at the University of Southern California.

Paula Soos, Covanta Energy

Paula Soos is the Senior Director for Government Relations at Covanta Energy. Before joining Covanta, Ms. Soos was environmental policy advisor to the Speaker of the Michigan House of Representatives and committee members. A Michigan native, she graduated from Michigan State University, James Madison College, in 1987 with her degree in International Relations.

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